STRUCTURAL FEATURES OF SPINELS OF THE IRON TRIAD ELEMENTS OBTAINED BY THE SHS METHOD

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Spinel-based materials are used in a variety of industries, including steel production, non-ferrous metal production, glass production, cement production, and in the chemical and nuclear industries. They are also used in the petrochemical industry to create highly selective catalysts. These materials are also used in multilayer filters and in magnetic applications. These materials have a wide range of uses, including as thermal insulation, corrosion-resistant coatings, pigments for a variety of products, such as engobe coatings for bricks, filler polymers, acrylic acid-based paints, powder coatings for metal products, and thermoplastic polymers used in 3D printing [1-5].

Blue, green, and khaki spinel pigments were produced using self-propagating high-temperature synthesis (SHS). The synthesis used Co_3O_4-ZnO-$Mg(NO_3)_2 \cdot 6H_2O$-$Al(OH)_3$, Ni_2O_3-ZnO-Cr_2O_3-$Al(OH)_3$ and Co_2O_3-Fe_2O_3-$Al(OH)_3$ mixtures. The product composition was characterized using X-ray diffraction and infrared spectroscopy. Aluminum powder was used as fuel.

The spinel-type pigments were created using a layer-by-layer combustion process, which involves two exothermic reactions: oxidation of aluminum and aluminothermic reaction. These fast, self-propagating reactions at high temperatures destroy the $Al(OH)_3$ structure in the initial mixture, creating gaseous products that prevent sintering of the pigments.

Scanning electron microscopy (Fig. 1) was used to study the surface morphology of the pigment powders.

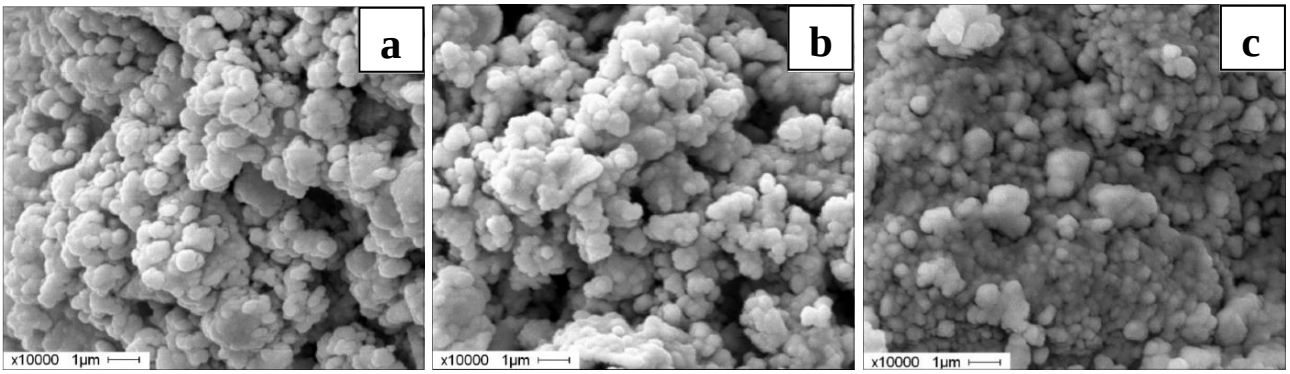

Fig.1. SEM images of iron triad-based spinels: (a) sample No.1; (b) sample No.2; (c) sample No.3 (Quanta 3D 200i, FEI Co.)

The structure of $Al(OH)_3$ in the starting mixture is quickly destroyed due to high-speed solid-state chemical reactions and high synthesis temperatures. As a result, gaseous products are formed that prevent the sintering of spinel crystals formed during synthesis.

Active aluminum oxide, which is produced by the thermal decomposition of $Al(OH)_3$, reacts with transition metal oxide to form spinel-type pigments with particle sizes of approximately 1-5 microns.

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